



**Europäisches
Patentamt**

**European
Patent Office**

**Office européen
des brevets**

Bescheinigung

Certificate

Attestation

Die angehefteten Unterla-
gen stimmen mit der
ursprünglich eingereichten
Fassung der auf dem näch-
sten Blatt bezeichneten
europäischen Patentanmel-
dung überein.

The attached documents
are exact copies of the
European patent application
described on the following
page, as originally filed.

Les documents fixés à
cette attestation sont
conformes à la version
initialement déposée de
la demande de brevet
européen spécifiée à la
page suivante.

Patentanmeldung Nr. Patent application No. Demande de brevet n°

03100640.6

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

THIS PAGE BLANK (USPTO)



Anmeldung Nr:
Application no.: 03100640.6
Demande no:

Anmeldetag:
Date of filing: 13.03.03
Date de dépôt:

Anmelder/Applicant(s)/Demandeur(s):

Ford Global Technologies, Inc.,
A subsidiary of Ford Motor Company
600 Parklane Towers East
Dearborn,
Michigan 48126
ETATS-UNIS D'AMERIQUE

Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se référer à la description.)

METHOD OF MANUFACTURING METALLIC COMPONENTS

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s)
revendiquée(s)
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/
Classification internationale des brevets:

B22D/

Am Anmeldetag benannte Vertragsstaaten/Contracting states designated at date of
filing/Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL
PT SE SI SK TR LI

THIS PAGE BLANK (USPTO)

Specification

The invention relates to a method of manufacturing metallic components consisting of at least two different materials, one of them being an iron-based alloy and the other
5 an aluminum-based alloy, and involving the stages recited in the preamble of claim 1, namely depositing a metallic layer onto the body made from the iron-based alloy, said layer being an aluminum-based alloy, preferably based on Al-Si or Fe, placing the coated body in a casting mold and casting an aluminum-based alloy about the coated body.

10

In order to meet both the tribological and the manufacturing requirements on internal combustion engines, and more specifically those placed on the system piston, piston ring and cylinder liner, wear-resistant bodies are cast in the engine block. Depending on the load, various materials may be combined. For reasons of weight, ease of
15 production and specific properties, aluminum alloys are used for engine blocks. In those regions of the system piston, piston ring and cylinder liner that are subject to tribological conditions, by contrast, iron-base alloys are made use of, the cylinder liner being cast in the engine block and the ring bearing element in the piston for example. Due to the different specific properties of the materials, to establish a
20 mechanical or metallurgical bond between the materials has always been a problem. Both the dynamic and the thermal properties in the internal combustion engines place high demands on the bond.

25

The „Alfin“ process described in DE 95 86 14 has long been known as a method of achieving a metallurgical bond. Here, an aluminum alloy, of a few hundredth of millimeters thick, is deposited onto an iron containing cylinder liner, thus providing a connection by diffusive bonding. As the cylinder liner is cast-in, the casting material is bonded to the diffusion layer.

30

To increase the metallurgical bond between the iron containing part and the aluminum layer deposited, the document DE 23 44 899 suggests to deposit a flux

-2-

onto the iron containing core. Although this measure may promote diffusive bonding with the iron containing core, it has no effect on the casting-in.

5 A problem with the bond between the layer created by the „Alfin“ process and the cast-in aluminum alloy is the oxyde layer that forms on the aluminum. The oxyde layers of the aluminum have a very high melting point of about 2000 °C, most current aluminum alloys having melting temperatures below 1000 °C.

10 In responding to this problem and to the afore mentioned ones, DE 43 25 864 A1 suggests a method in which a layer of chromium is electroplated above the aluminum layer. Although a bond achieved according to this method is susceptible to provide increased adhesion, it implies at the same time a greater number of barrier layers in which pores and bonding failures may arise. Another drawback is that an oxyde layer forms on the layer of chromium, said oxyde layer making wetting more difficult.

15 It is the object of the present invention to overcome the drawbacks of prior art and to enhance the metallurgical bond between the components made from various materials. In accordance with the invention, the solution to this object is achieved by the features recited in claim 1. Advantageous developments of the invention are
20 recited in the claims 2 through 5.

The afore mentioned drawbacks are advantageously overcome by spraying and/or blasting silicon powder or Borax onto the metallic layer of the body made from the iron-based alloy prior to placing it in the casting mold.

25 The invention teaches to activate the surface of the liner by the blasting of silicon and/or Borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, hydrated sodium borate) powder particles for improved bonding of the cylinder liner to the cylinder block material. It is especially advantageous if the size of the blasted particles is about 200 and 300 μm .

30 This blasting process will create a mechanical bond with the cylinder liner material.

This is applicable for pure gray cast iron cylinder liners as well as for gray cast iron cylinder liners with an outer coating like sprayed AlSi or iron. In both conditions, a mechanical bond between the blasted powder and the outer surface of the cylinder liner is the result. With the help of the now added silicon and/or Borax, the bond
5 between the liner and the cylinder block can be improved. During the melting process, the added silicon is reacting with aluminum of the block material. That means that a strong mechanical bond is created. With the help of Borax, this process can be improved. The effect of adding Borax is that the oxide layer of the aluminum cylinder block will be destroyed. The oxide layer of the aluminum is the major
10 obstacle in creating a good bond with other materials as well as with aluminum itself. The other positive effect of using Borax is the decrease in melting point of the material in the outer surface region. On the one hand, this effect destroys the oxide layer and on the other hand, the two materials can start to create a metallurgical bond earlier. The two components have more time to establish a very good bond.

15 The invention will be described herein after in closer detail and a sequence of the process meeting the claims of said invention will be explained.

The example describes how to cast a cylinder liner in an engine block. Prior to
20 depositing the metallic layer, the exterior surface of the cylinder liner is at need processed in order to achieve the required surface quality. The metallic layer which is now to be applied may be produced either by thermal spray application or by the „Alfin“ process. The metallic layers of preference are AlSi or Fe-sprayed layers. Next, and prior to placing the body into the casting mold, the metallic layer is sprayed
25 and/or blasted with silicon powder and/or Borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, hydrated sodium borate). The preferred particle size of the Borax or silicon powder used ranges from 200 to 300 μm . The silicon and/or Borax particles adhere to the surface of the liner, i.e. on the AlSi or Fe sprayed layer. Next, the cylinder liner is placed in the casting mold and, upon completion thereof, the cylinder block is cast.

30 Liquid aluminum is cast about the cylinder liners. As already described herein above,

-4-

the deposited Si- and/or Borax particles provide enhanced adherence. It is of course also possible to coat other components to activate the surfaces thereof. These may for example be valve seats, valve guides or bearing shells. In some cases, these components are cast in the aluminum cylinder blocks or aluminum cylinder heads.

- 5 . Prior to placing the parts in the casting mold, they are also sprayed and/or blasted with silicon powder and/or Borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, hydrated sodium borate). Again, the advantage lies in the enhanced adhesion and, as a result thereof, in the improved heat dissipation. In the region of the cylinder head (valve seat and valve guide), the valve is moreover protected from the action of too strong a heat.

Claims

1. A method of manufacturing metallic components consisting of at least two different materials, one of them being an iron-based alloy and the other an aluminum-based alloy, and involving the stages of:
- depositing a metallic layer onto the body made from the iron-based alloy, said layer being an aluminum-based alloy, preferably based on Al-Si or Fe, and
 - placing the coated body in a casting mold and casting an aluminum-based alloy about the coated body,
- characterised in that the metallic layer of the body made from the iron-based alloy is sprayed and/or blasted with silicon powder and/or Borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, hydrated sodium borate) prior to placing said body in the casting mold.
2. The method of claim 1, characterised in that the particle size of the Borax or silicon powder used ranges from 200 to 300 μm .
3. The method of claim 1 and 2, characterised in that the body made from the iron-based alloy is a gray cast iron cylinder liner for a piston of an internal combustion engine.
4. A piston of an internal combustion engine manufactured in accordance with one of the claims 1 through 3, characterised in that the cylinder liner coated with silicon powder and/or Borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, hydrated sodium borate) is placed in a casting mold and an aluminum alloy is then cast about it.
5. The method of claim 1 and 2, characterised in that the body made from the iron-based alloy is a valve seat, a valve guide or a bearing shell as a part of an internal combustion engine.

THIS PAGE BLANK (USPTO)

Abstract**5 Method of Manufacturing Metallic Components**

A method of manufacturing metallic components consisting of at least two different materials, one of them being an iron-based alloy and the other an aluminum-based alloy, and involving the stages of: depositing a metallic layer onto the body made
10 from the iron-based alloy, said layer being an aluminum-based alloy, preferably based on Al-Si or Fe, placing the coated body in a casting mold and casting an aluminum-based alloy about the coated body, wherein the metallic layer of the body made from the iron-based alloy is sprayed and/or blasted with silicon powder and/or
15 Borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, hydrated sodium borate) prior to placing said body in the casting mold.

THIS PAGE BLANK (USPTO)